

BACTERIAL OXIDATION OF METHYL BROMIDE: RESULTS OF SOIL FLUX CHAMBER EXPERIMENTS.

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Strain IMB-1 is an aerobic, facultative methylotroph which grows using methyl bromide (MeBr) as a sole source of carbon and energy which it oxidizes to CO₂ plus Br⁻ (Miller et al., 1997; Connell Hancock et al., 1998). In laboratory experiments, addition of either MeBr-grown or glucose-grown cell suspensions of strain IMB-1 to enclosed soils rapidly sped up their ability to oxidize MeBr (Connell Hancock et al., 1998). These results suggested that impregnation of soil surfaces with cell suspensions of strain IMB-1 during fumigation events may be a means to significantly reduce emissions of MeBr to the atmosphere. The work we report herein was undertaken to determine if significant degradation of MeBr could be achieved by impregnating soil surfaces with cell suspensions of strain IMB-1. We filled circular “kiddie pools” (diameter = ~ 1.5 m) to a depth of ~ 25 cm. with sandy soils collected from a local strawberry farm. We then inserted collars of metal flux chambers into the soils, and added washed suspensions of either glucose- or methylamine-grown cells of strain IMB-1 over the soils enclosed within the chamber’s base (cell density = ~ 1 – 2 x 10¹² cells/600 cm²). Control chambers received the same volume of cell-free buffer solution. The metal chamber tops were then placed over the collars and MeBr plus SF₆ were injected, the latter to act as an internal standard. Over the course of 24 h incubation periods, both MeBr and SF₆ levels in the chambers dropped, in part due to leakage of the gases out of the bottom. However, the ratio of MeBr:SF₆ was significantly lower (2-3 fold) in chambers incubated with cell suspensions of strain IMB-1 compared to those without, indicating that enhanced consumption of MeBr was occurring in the chambers containing strain IMB-1. Chloropicrin (1 % of fumigation mixture) did not affect the degradation of MeBr. The oxidation of MeBr was confirmed with soil subsamples taken from the chambers after the incubation was completed. Soils with cells oxidized ¹⁴C-MeBr to ¹⁴CO₂ while those without cells did not. This activity remained vigorous in soils even 6 days after they were inoculated with cells. Use of MeBr:SF₆ ratios for quantitative purposes of determining the extent of MeBr degradation, however, could not be achieved. Therefore, we examined the amount of Br⁻ accumulated in the soils underneath the chambers after the incubations were completed. The highest amount of mineralization we observed in 24 h incubations was 40 – 80 % of the MeBr added. Although these results were encouraging, we did not always achieve such success. We believe that this can be explained by the 12 – 24 h “lag” period during which glucose-grown cells of strain IMB-1 adapt to consume MeBr (Connell Hancock et al., 1998). This may be circumvented by adapting cells to MeBr prior to their emplacement in the chambers. Nonetheless, these results demonstrate that addition of cell suspensions of strain IMB-1 to soil surfaces is a viable concept for lowering MeBr emissions to the atmosphere from fumigated soils. However, more work with these mesocosms is needed before full-scale efforts with experimental soil plots can be contemplated.

Miller, L.G., T.L. Connell, J.R. Guidetti, and R.S. Oremland. 1997. Bacterial oxidation of methyl bromide in fumigated agricultural soils. *Appl. Environ. Microbiol.* 63: 4346 – 4354.

Connell Hancock, T.L., A.M. Costello, M.E. Lidstrom, and R.S. Oremland. 1998. Strain IMB-1, a novel bacterium for the removal of methyl bromide in fumigated agricultural soils. *Appl. Environ. Microbiol.* 64: 2899 – 2905.

